

CORRECTED
VERSION*

PCT

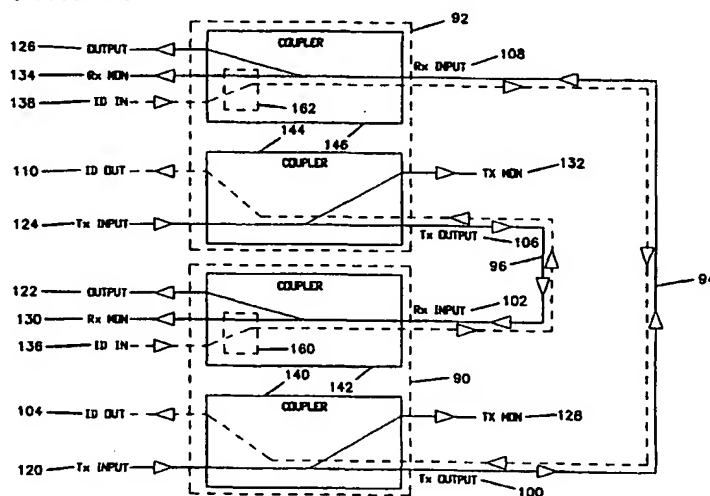
WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : G02B 6/44, F21V 8/00		A3	(11) International Publication Number: WO 00/05611
			(43) International Publication Date: 3 February 2000 (03.02.00)
(21) International Application Number: PCT/US99/15840		(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 14 July 1999 (14.07.99)			
(30) Priority Data: 09/121,066 21 July 1998 (21.07.98) US			
(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]; 12501 Whitewater Drive, Minnetonka, MN 55343 (US).			
(72) Inventor: VIGLIATURO, Shari, Lynn, Williams; 6240 Elm Tree Avenue, Excelsior, MN 55331 (US).			
(74) Agent: BRUESS, Steven, C.; Merchant & Gould P.C., 3100 Norwest Center, 90 South Seventh Street, Minneapolis, MN 55402-4131 (US).		Published <i>With international search report.</i>	
		(88) Date of publication of the international search report: 15 June 2000 (15.06.00)	

(54) Title: FIBER OPTIC CONNECTOR MODULE



(57) Abstract

A fiber optic module includes front adapters for connection to fiber optic connectors, and rear adapters for connection to fiber optic connectors. The module includes two circuits having passive optical couplers inside, and adapters exposed along the front and the rear of the module. The module is usable in cross-connect applications with itself or with other modules. The adapters are selectively connectable to fiber optic connectors. The front adapters of the module include two receive input ports and two transmit output ports. The front of the module also includes two visual indicators, one for each circuit. The visual indicators include a lens cap at least partially transparent to visual light in light communication with an optical fiber. The rear adapters of the module include two transmit input ports and two transmit output ports. Monitor ports are also located on the rear for both the transmit and receive signals. The receive monitor ports also function as the input ports for an identification signal sent in the reverse direction for illuminating the visual indicators along the front of the module or another module. Alternatively, separate identification signal input ports can be provided on the front as adapters.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

FIBER OPTIC CONNECTOR MODULE

Field of the Invention

5 The present invention relates to fiber optic modules for use in cross-connecting fiber optic equipment.

Background of the Invention

10 The telecommunications and data transmission industries are rapidly expanding their development of fiber optic transmission systems. Historically, telecommunications signals and data have been transmitted over wire lines such as twisted pair or coaxial cables. In order to accommodate higher signal rate speeds, the industry is turning to increased use of fiber optic cables as the transmission medium.

15 As the use of fiber optic cables increases, the need for peripheral equipment has increased. For example, it is desirable to have access to a fiber optic line for the purpose of either re-routing the line in the event of damage to the line or to have access to the line for purposes of monitoring or testing the line.

20 Fiber optic peripheral equipment for cable management, cable storage and connection capabilities are well known. The use of modular fiber optic connector modules is known for performing so-called cross-connect applications. U.S. Patent Nos. 5,432,875 and 5,363,465 to ADC Telecommunications, Inc. concern fiber optic connector modules and chassis designs for receiving the modules in cross-connect applications.

25 PCT WO97/41720 also concerns a fiber optic module for use in cross-connect applications. The document discloses optical signal routing, monitoring, and visual path identification capabilities.

There is a continuing need for fiber optic modules which provide optical signal routing, monitoring, and visual path identification capabilities.

Summary of the Invention

30 A fiber optic module for mounting to a chassis for holding one or more modules has front and rear access defined by a plurality of connection locations. The connection locations are linked by optical couplers. Two circuits are disposed within the housing of the module. The module is used to cross-connect fiber optic equipment via patch cords on the front connection locations.

35 In one preferred embodiment, the front of the module includes four adapters for connection to fiber optic connectors, and two visual indicators for visual path identification for the circuits. The front may also include visual signal

identification input ports. The rear includes eight adapters for connection to fiber optic connectors.

The rear of the module may include angled linear segments for the connection locations. The front may include adapters in a linear array, each held at an angle to the front of the module by an angled retainer.

The visual indicators may include a lens cap at least partially transparent to visual light connectable to an optical fiber. During injection of an optical signal through the fiber in the visible light range, the lens cap will illuminate.

Brief Description of the Drawings

In the drawings, wherein like reference letters and numerals indicate corresponding elements throughout the several views:

FIG. 1 shows a perspective view of a chassis including several fiber optic modules mounted within the chassis;

FIG. 1A is a front view of the chassis with the front door open, and showing two four port fiber optic modules, and two six port fiber optic modules mounted to the chassis;

FIG. 1B is a rear view of the chassis and modules shown in FIG. 1A with the rear door open;

FIG. 2 shows a perspective side view of one of the four port fiber optic modules;

FIG. 3 is a top view of the module of FIG. 2;

FIG. 4 is a front view of the module of FIG. 2;

FIG. 5 is a rear view of the module of FIG. 2;

FIG. 6 is a schematic circuit path drawing showing the exemplary signal paths for the main signals (solid) and for the visible continuity check and identifier signals (dashed);

FIG. 7 shows only the circuit paths for the main signals of the circuit drawing of FIG. 6;

FIG. 8 shows only the circuit paths for the visible continuity check and identifier signals of the drawing of FIG. 6;

FIG. 9 shows an adapter and retainer of the type along the front of the module;

FIG. 10 shows an adapter and retainer of the type along the rear of the module;

FIG. 11 shows a further view of the adapter and retainer of FIG. 10;

FIG. 12 is a perspective view of the visual indicator for the signal identifier output device along the front of the module;

FIG. 13 is a cross-sectional side view of the signal identifier output device;

FIG. 14 is a cross-sectional view of the lens cap and the nut of the signal identifier output device;

FIG. 15 is a cross-sectional side view of the sleeve and the ferrule of the signal identifier output device;

FIG. 16 is an exploded view of the signal identifier output device;

FIG. 17 is a perspective view of a portion of the module housing; and

FIG. 18 is a perspective view of a further portion of the module housing.

Detailed Description of the Preferred Embodiments

Referring now to FIGS. 1, 1A and 1B, a fiber optic chassis 20 is shown for holding a plurality of the fiber optic modules 22, 23. Chassis 20 is mountable to a rack (not shown) for holding chassis 20. Chassis 20 includes an outer housing 24, and a pivotable front door 26. Front door 26 allows access to an interior of chassis 20, so as to access individual modules 22, 23 such as for repair or replacement of modules 22, 23 or to connect or disconnect the modules with other modules or fiber optic equipment. Rear door 27 also pivots in a similar manner to allow access to the rear areas of modules 22, 23. Housing 24 includes a plurality of guides 28 for holding the individual modules 22, 23 in a horizontal manner. Side openings 29 allow for cable pathways into and out of chassis 20.

Modules 22 have four connection locations or ports along the front, and modules 23 have six connection locations or ports along the front. As will be described in greater detail below, modules 22, 23 are similar in many respects. Both modules 22, 23 preferably include two circuits for use in cross-connecting fiber optic equipment connected to the modules at rear connection locations or ports. The modules 22, 23 may also be used for inter-connecting fiber optic equipment as desired.

Both modules 22, 23 also allow signal monitoring and visual continuity checks for the circuits. One difference is that to inject an identification signal into one of the circuits, the input port is on the rear for module 22 and on the front for module 23.

Referring now to FIGS. 2-5, module 22 has a module housing 32 including a front face 40, and a generally opposite facing rear face 42. The front and rear faces 40, 42 each define connection locations 60, 62 for connecting module 22 to fiber optic cables. In the embodiment shown, front face 40 is generally planar, and rear face 42 generally includes at least one angled, linear segment, and

preferably two angled, linear segments 44. The angled segments allow for more connection locations 62 than would be possible with a planar rear face 42 parallel to front face 40. In the embodiment shown, eight connection locations are defined on rear face 42, four per segment 44. In the embodiment shown, the connection locations 60, 62 are both angled relative to front face 40.

Module 22 further includes opposed major planar sides 48, 50. Major sides 48, 50 define a top and a bottom in the illustrated embodiment for module 22. Module 22 further includes opposed minor planar sides 52, 54 defining sides of module 22 in the embodiment shown. Major side 48 has side extensions 56 which form slide rails 56 for receipt in guides 28 of chassis housing 24. Module 22 is mounted in either orientation as shown in FIGS. 1, 1A, and 1B. When modules 22 are flipped between the left and right sides, angled connection locations on the front and the rear are directed to respective left and right sides of chassis 20 as shown. Also, module 22 can be mounted vertically if desired.

One construction of module housing 32 is to form front face 40, major side 50, and minor sides 52, 54 from a single main piece 80 (see FIG. 17), such as from sheet metal. A separate cover 82 (see FIG. 2) and a separate saw tooth-shaped rear piece 84 (see FIGS. 2 and 18), such as from sheet metal, both attach to single main piece 80 to form the housing for the optical couplers and adapters which permits connection to optical equipment. The attachment of parts can be by fasteners, such as screws.

Module 22 includes a plurality of first adapters 60 exposed along front face 40 for the front connection locations for connection to fiber optic connectors. A plurality of second adapters 62 are positioned along rear face 42 for the rear connection locations, also for connection to fiber optic connectors. The first and second adapters 60, 62 are preferably positioned in linear arrays parallel to front face 40. The adapters shown are FC type, but could also be SC, ST, or any other suitable connection scheme. The plurality of first adapters 60 are used to cross-connect fiber optic equipment connected to the plurality of rear adapters 62 of module 22. Alternatively, the equipment may be connected to the rear adapters 62 module 22 and to another module. The two modules are cross-connected to connect the equipment in this situation. Front face 40 of module 22 also includes two visual indicators 64, 66 connected to the optical components within module 22, as will be described in greater detail below. Alternatively, module 22 can be interconnected to other equipment or another module via front adapters 60.

Module 22 further includes end flanges 68, 70 for use in mounting module 22 to chassis 20. Locking members 72 releasably hold flanges 68, 70 to holes 30 of housing 24 of chassis 20. Locking members 72 are of the type shown

and described in U.S. Patent No. 5,363,465. Locking members 72 operate to lock or release by rotating 90 degrees. Other locking members, including screws may be used as desired.

5 Front adapters 60 define receive and transmit ports for two passive optical circuits contained within module 22. In a cross-connect application, rear adapters 62 are connected to fiber optic equipment to be cross-connected at the front adapters 60 through patch cords. The two circuits each allow optical signal routing, monitoring and signal path identification.

10 Module 22 of one preferred embodiment fits into existing chassis 20 having individual module opening widths of about 7.237 inches, and heights of about 1.100 inches. Holes 30 are positioned about 7.905 inches apart. Module 22 of one preferred embodiment has a length between sides 52, 54 of about 7.11 inches, a length between the outside edges of side extensions 56 of about 7.96 inches, a length between sides 48, 50 of about 1.06 inches, and a length of front face 40 including
15 flanges 68, 70 of about 8.61 inches. Module 22 with two independent circuits has double the density over a module 22 having only a single circuit.

Module 22 includes two plugs 88 which fill unused holes in front face 40 in module 22. In module 23, adapters 60 are positioned in front face 40 (see FIG. 1A) where the plugs are in module 22 in a similar manner as the other adapters 60,
20 for connection to a fiber optic connector.

FIGS. 6-8 illustrate the circuit paths through modules 22, 23 during main signal usage (FIGS. 6 and 7), and visual continuity check and identifier usage (FIGS. 6 and 8). Main signals are at the 1310 nanometer (nm) window (for example, 1260 - 1360 nm) or the 1550 nm window (for example, 1430 - 1580 nm).
25 During visual continuity checking and identification, the identification signals are passed through the circuits in a reverse direction to the main signals. Further, the identification signals are at a wavelength of visible light, such as 400-700 nm.

Referring now to FIGS. 4 and 6, along the front of module 22, two adapters 60 define a first transmit output port 100 and a first receive input port 102 as part of a first circuit 90. Adapters 60 further define a second transmit output port 106, and a receive input port 108 as part of a second circuit 92. A first LED 104 defines first visual indicator 64 and is linked to first circuit 90 for circuit continuity checking and identification. A second LED 110 defines second visual indicator 66 and is linked to second circuit 92 for circuit continuity checking and identification.
30
35 FIGS. 6-8 are schematics which show the circuit paths during use of module 22 where first circuit 90 is cross-connected to second circuit 92 with patch cords 94, 96. Each of first and second circuits 90, 92 are also cross-connectable to circuits of

other modules. Each of circuits 90, 92 are inter-connectable to other modules or equipment.

Adapters 62 define various ports for first and second circuits 90, 92. Specifically, a first transmit input port 120 and a first receive output port 122 are
5 linked to first circuit front ports 100, 102 through optical couplers within module 22. Also, a second transmit input port 124 and a second receive output port 126 are linked to second circuit front ports 106, 108 through optical couplers. A first transmit monitor port 128 and a first receive monitor port 130 are part of first circuit 90, and are positioned along rear face 42. A second transmit monitor port 132 and a
10 second receive monitor port 134 are part of second circuit 92, and are also positioned along rear face 42.

Receive monitor port 130 also is utilized as an identification input port for injecting a signal into first circuit 90 to trace a circuit path through module 22 to another circuit in module 22 or to another module altogether.

15 In FIG. 6, receive monitor port 130 is shown separate from identification input port 136. This is the case for six port module 23. For four port module 22, the two ports 130, 136 are combined and share the same connector location. This requires an operator to selectively use the combined port as either a monitor or a visual indicator for continuity checking.

20 Receive monitor port 134 is also utilized as an identification input port for injecting a signal into second circuit 92 to trace a circuit path through module 22 to another circuit in module 22 or to another module altogether.

In FIG. 6, receive monitor port 134 is shown separate from identification input port 138. As above for ports 130, 136, ports 134, 138 are
25 separate ports for module 23. For module 22, they are the same connection location.

A first optical coupler 140, such as a two-by-two splitter, links transmit input port 120 to transmit output port 100 and transmit monitor port 128, each receiving a portion of the signal, such as 50%. A second optical coupler 142, such as a one-by-two splitter links receive input port 108 to receive output port 126
30 and receive monitor port 134, each receiving a portion of the signal, such as 50%. Third and fourth optical couplers 144 and 146 are similarly configured for splitting of the signals from an input port between the respective output and monitor ports. Each of couplers 140, 142, 144, 146 allow the identification signal to pass in the reverse direction to the main signal.

35 If separate ports are desired for the receive signal monitor function and the identification signal input function, a further optical coupler is provided. In first circuit 90, a secondary coupler 160, such as a 1x2 splitter, is provided where monitor port 130 receives about 95% of the signal, and the remaining about 5% is

received by the input port 136. A similar construction is provided for secondary coupler 162 of second circuit 92. Each of couplers 160, 162 allow the identification signal to pass in the reverse direction to the main signal.

Referring now to FIG. 9, adapter 60 is shown in greater detail with a
5 retainer 200 for holding adapter 60 in an opening 202 (see FIG. 18) of module housing 32. Retainer 200 holds adapter 60 at a non-perpendicular angle relative to the axis of opening 202. Retainer 200 snaps into opening 202. Retainer 200 is also removable, as desired. U.S. Patent No. 5,214,735 to ADC Telecommunications, Inc. shows and describes an example retainer 200. Other retainers are possible for
10 mounting adapters 60 to module 22. Once mounted, end 205 of adapter 60 is exposed for connection to a connector of a fiber optic patch cord, shown schematically in FIGS. 6-8 as cords 94, 96.

Referring now to FIGS. 10 and 11, adapter 62 is shown in greater detail with a retainer 208 for holding adapter 62 in one of the openings 210 along
15 rear face 42 of module housing 32 (see FIG. 18). Retainer 208 snaps into opening 200, and is removable as desired. Adapter 62 is shown with protective caps 204. Other retainers are possible for mounting adapters 62 to module 22. Once mounted, end 207 is exposed for connection to a connector of a fiber optic cable. As illustrated, adapters 60, 62 include protective end caps 204, which are removed prior
20 to connection to a connector. Adapters 60, 62 also allow connection at opposite ends 206, 209 to FC type connectors so as to connect easily to the optical couplers within module 22. Other connector types can be used, as desired.

Referring now to FIGS. 13-16, first LED 104 is shown in greater detail. Second LED 110 is constructed in a similar manner. Each LED includes a
25 lens portion optically linked to a fiber connected to the main circuits to provide a continuity check for each circuit. A lens cap 300 is held by a nut 302 to an outer sleeve 306. Lens cap 300 is made from a material at least partially transparent to visible light. An integrally molded lens cap 300 and nut 302 is also possible. An inner ferrule 304 held to outer sleeve 306, such as adhesive, holds an optical fiber
30 310 such that an end of the fiber is adjacent to cap 300. An outer boot 308 provides strain relief for outer sleeve 306. Nut 302 includes threads 320 which threadably mount to threads 322 of outer sleeve 306. Cap 300 includes a plurality of flexible legs 324 which enable positioning of a recessed region 326 disposed on an outer surface of cap 300 around a shoulder 330 of nut 302. Such a construction allows
35 retention of cap 300 with nut 302. By threading nut 302 to outer sleeve 306, front face 40 of module housing 32 is trapped between end 331 of nut 302 and shoulder 332 of outer sleeve 306. When visible light is passed through fiber 310, the light illuminates lens cap 300 providing a visual indicator to the operator. In an

alternative embodiment, lens cap 300 and the remaining components necessary to attach it to a fiber, can be molded from plastic, such as a one-piece molded part.

Having described the present invention in a preferred embodiment, modifications and equivalents may occur to one skilled in the art. It is intended that
5 such modifications and equivalents shall be included within the scope of the claims which are appended hereto.

WHAT IS CLAIMED IS:

1. A fiber optic module mountable to a chassis comprising:
a module housing having front and rear faces, opposed major sides, and
opposed minor sides defining an enclosed interior, the front face including mounting
5 flanges for mounting the module to the chassis;
a plurality of exposed first adapters along the front face, each of the plurality
of first adapters connectable to a fiber optic connector external to the module;
a plurality of exposed second adapters along the rear face, each of the
plurality of second adapters connectable to a fiber optic connector external to the
10 module;
wherein the plurality of first adapters define:
a first signal transmit output port;
a first signal receive input port;
a first signal identification input port;
15 a second signal transmit output port;
a second signal receive input port; and
a second signal identification port;
wherein the plurality of second adapters define:
a first signal transmit input port;
20 a first signal receive output port;
a second signal transmit input port;
a second signal receive output port;
a first signal transmit monitor port;
a first signal receive monitor port;
25 a second signal transmit monitor port; and
a second signal receive monitor port;
wherein the front face further includes first and second visual indicators;
wherein the plurality of first adapters and the first and second visual
indicators are positioned between the mounting flanges along the front face;
30 a first optical signal coupler disposed within the enclosed interior connecting
the first signal transmit input port along the rear face to the first signal transmit
monitor port along the rear face and the first signal transmit output port along the
front face at a first wavelength, and wherein the first signal transmit output port is
connected to the first visual indicator at a second wavelength;
35 a second optical coupler disposed within the enclosed interior connecting the
first signal receive input port along the front face to the first signal receive output
port along the rear face and the first signal receive monitor port along the rear face at
a third wavelength, and wherein the first signal identification input port along the

front face is connected to the first signal receive input port along the front face at a fourth wavelength;

5 a third optical signal coupler disposed within the enclosed interior connecting the second signal transmit input port along the rear face to the second signal transmit monitor port along the rear face and the second signal transmit output port along the front face at a fifth wavelength, and wherein the second signal transmit output port is connected to the second visual indicator at a sixth wavelength; and

10 a fourth optical coupler disposed within the enclosed interior connecting the second signal receive input port along the front face to the second signal receive output port along the rear face and the second signal receive monitor port along the rear face at a seventh wavelength, and wherein the second signal receive identification input port along the front face is connected to the second signal receive input port along the front face at an eighth wavelength.

15 2. The fiber optic module of claim 1, wherein the first, third, fifth, and seventh wavelengths are between approximately 1260 nanometers and approximately 1360 nanometers.

20 3. The fiber optic module of claim 1, wherein the first, third, fifth, and seventh wavelengths are between approximately 1430 nanometers and approximately 1580 nanometers.

25 4. The fiber optic module of claim 1, wherein the second, fourth, sixth and eighth wavelengths are between approximately 400 nanometers and approximately 700 nanometers.

5. The fiber optic module of claim 1, wherein the plurality of first adapters are disposed in a linear array.

30 6. The fiber optic module of claim 5, wherein the plurality of first adapters are at a non-perpendicular angle to a plane defined by the front face.

35 7. The fiber optic module of claim 1, wherein the rear face includes two linear segments, each segment positioned at a non-perpendicular angle to a plane defined by the front face.

8. The fiber optic module of claim 1, wherein the plurality of first and second adapters are mounted to the respective front and rear faces with releasable clips.

9. The fiber optic module of claim 8, wherein the releasable clips mounting the plurality of adapters to the front face are angled clips for holding the adapters at a non-perpendicular angle relative to the front face.
- 5 10. The fiber optic module of claim 1, wherein the plurality of first and second adapters are releasably connectable to fiber optic connectors disposed with the module housing.
- 10 11. The fiber optic module of claim 1, wherein the first and second visual indicators each include a lens cap at least partially transparent to visual light.
12. The fiber optic module of claim 11, wherein the first and second visual indicators each further include:
- 15 a nut mounted to the lens cap;
a sleeve threadably mountable to the nut;
a ferrule for holding an optical fiber, the ferrule mounted to the sleeve;
the nut and the sleeve threadably mountable together to trap a portion of the module housing therebetween.
- 20 13. The fiber optic module of claim 1, further comprising a releasable locking member mounted to each mounting flange for mounting the module to the chassis.
14. A fiber optic module mountable to a chassis comprising:
- 25 a module housing having front and rear faces, opposed major sides, and opposed minor sides defining an enclosed interior, the front face including mounting flanges for mounting the module to the chassis;
a plurality of exposed first adapters along the front face, each of the plurality of first adapters connectable to a fiber optic connector external to the module;
a plurality of exposed second adapters along the rear face, each of the
30 plurality of second adapters connectable to a fiber optic connector external to the module;
- wherein the plurality of first adapters define:
- 35 a first signal transmit output port;
a first signal receive input port;
a second signal transmit output port; and
a second signal receive input port;
- wherein the plurality of second adapters define:
- a first signal transmit input port;

- a first signal receive output port;
a second signal transmit input port;
a second signal receive output port;
a first signal transmit monitor port;
5 a first signal receive monitor and identification input port;
a second signal transmit monitor port; and
a second signal receive monitor and identification input port;
wherein the front face further includes first and second visual indicators;
wherein the plurality of first adapters and the first and second visual
10 indicators are positioned between the mounting flanges along the front face;
a first optical signal coupler disposed within the enclosed interior connecting
the first signal transmit input port along the rear face to the first signal transmit
monitor port along the rear face and the first signal transmit output port along the
front face at a first wavelength, and wherein the first signal transmit output port is
15 connected to the first visual indicator at a second wavelength;
a second optical coupler disposed within the enclosed interior connecting the
first signal receive input port along the front face to the first signal receive output
port along the rear face and the first signal receive monitor and identification input
port along the rear face at a third wavelength, and wherein the first signal receive
20 monitor and identification input port is connected to the first signal receive input
port along the front face at a fourth wavelength;
a third optical signal coupler disposed within the enclosed interior connecting
the second signal transmit input port along the rear face to the second signal transmit
monitor port along the rear face and the second signal transmit output port along the
25 front face at a fifth wavelength, and wherein the second signal transmit output port is
connected to the second visual indicator at a sixth wavelength; and
a fourth optical coupler disposed within the enclosed interior connecting the
second signal receive input port along the front face to the second signal receive
output port along the rear face and the second signal receive monitor and
30 identification input port along the rear face at a seventh wavelength, and wherein the
second signal receive monitor and identification input port is connected to the
second signal receive input port along the front face at an eighth wavelength.
15. A fiber optic continuity indicator device for a fiber optic module including a
35 housing, the device comprising:
a lens cap at least partially transparent to visible light;
a nut mounted to the lens cap;
a sleeve threadably mountable to the nut;

a ferrule for holding an optical fiber, the ferrule mounted to the sleeve;
the nut and the sleeve threadably mountable together to define a space for
receipt of a portion of the housing of the fiber optic module.

- 5 16. A fiber optic module mountable to a chassis comprising:
a module housing having front and rear faces, opposed major sides, and
opposed minor sides defining an enclosed interior, the front face including mounting
flanges for mounting the module to the chassis;
a plurality of exposed first adapters along the front face, each of the plurality
10 of first adapters connectable to a fiber optic connector external to the module;
a plurality of exposed second adapters along the rear face, each of the
plurality of second adapters connectable to a fiber optic connector external to the
module;
wherein the plurality of first and second adapters are optically connected to
15 fiber optic component disposed in the enclosed interior;
wherein the rear face includes at least two linear segments, each segment
positioned at a non-perpendicular angle to a plane defined by the front face.
17. The fiber optic module of claim 16, wherein the plurality of first adapters are
20 at a non-perpendicular angle to a plane defined by the front face.
18. The fiber optic module of claim 16, wherein the plurality of first and second
adapters are mounted to the respective front and rear faces with releasable clips.
- 25 19. A fiber optic module mountable to a chassis comprising:
a module housing having front and rear faces, opposed major sides, and
opposed minor sides defining an enclosed interior, the front face including mounting
flanges for mounting the module to the chassis;
a plurality of exposed first adapters along the front face, each of the plurality
30 of first adapters connectable to a fiber optic connector external to the module;
a plurality of exposed second adapters along the rear face, each of the
plurality of second adapters connectable to a fiber optic connector external to the
module;
wherein the plurality of first and second adapters are optically connected to a
35 fiber optic component disposed in the enclosed interior;
wherein the front face includes a visual indicator optically connected to the
fiber optic component, the visual indicator including a lens cap at least partially
transparent to visual light.

FIG. 1

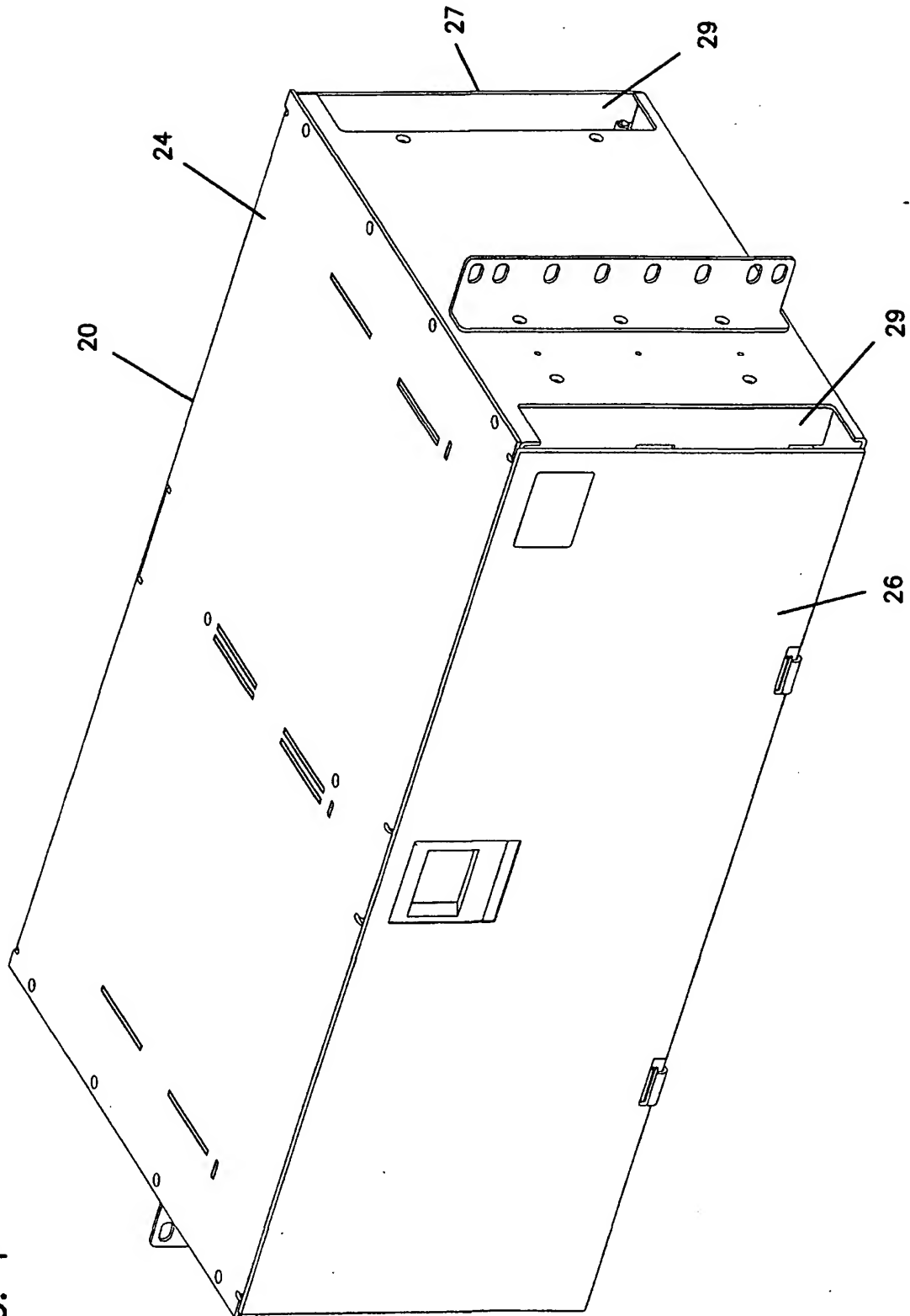


FIG. 1A

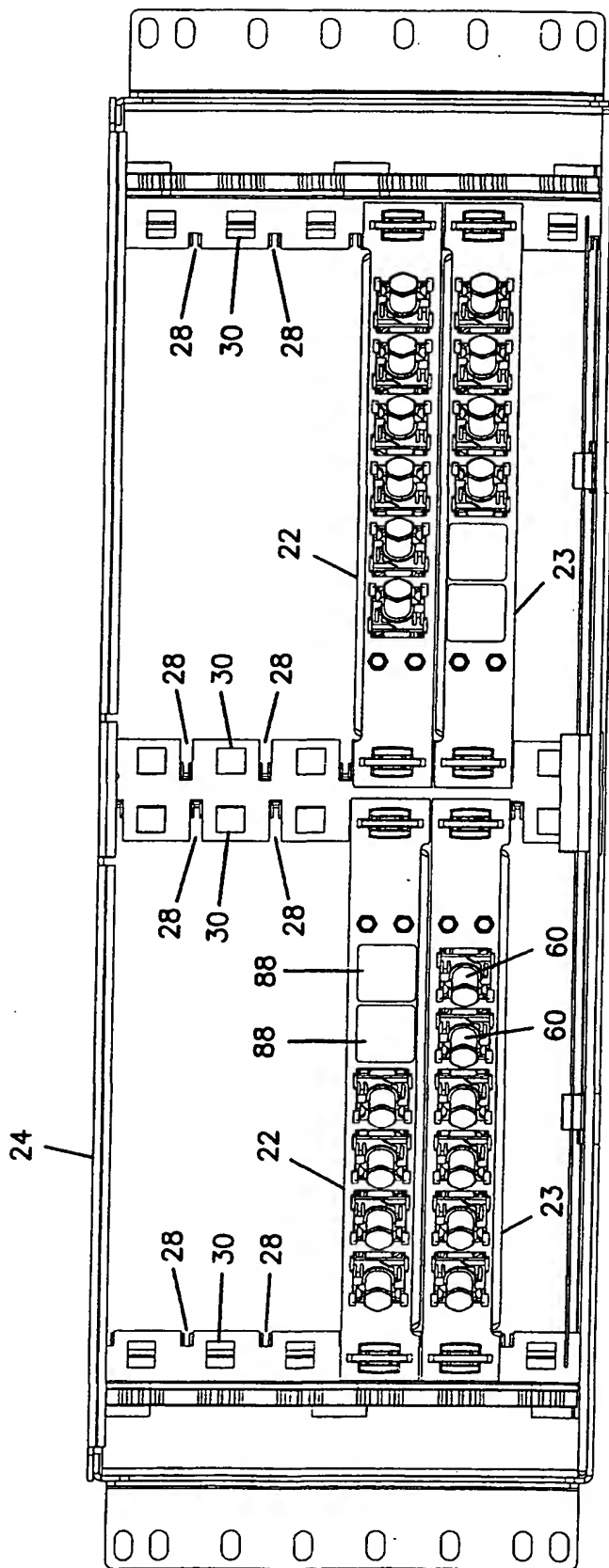
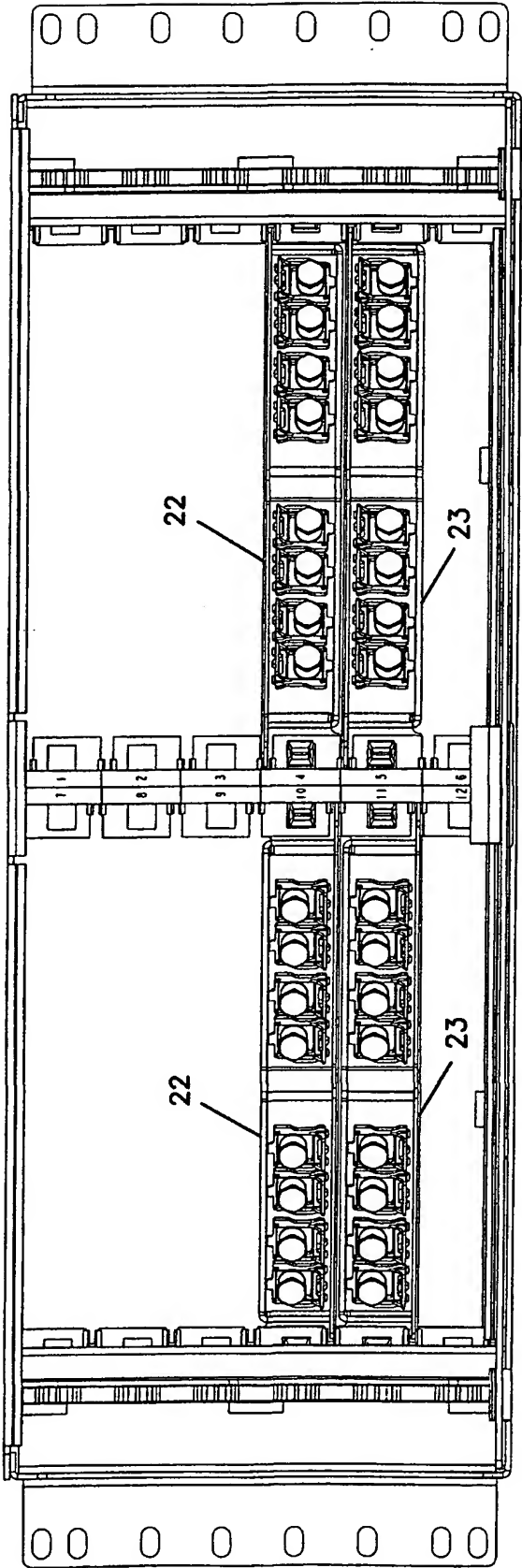
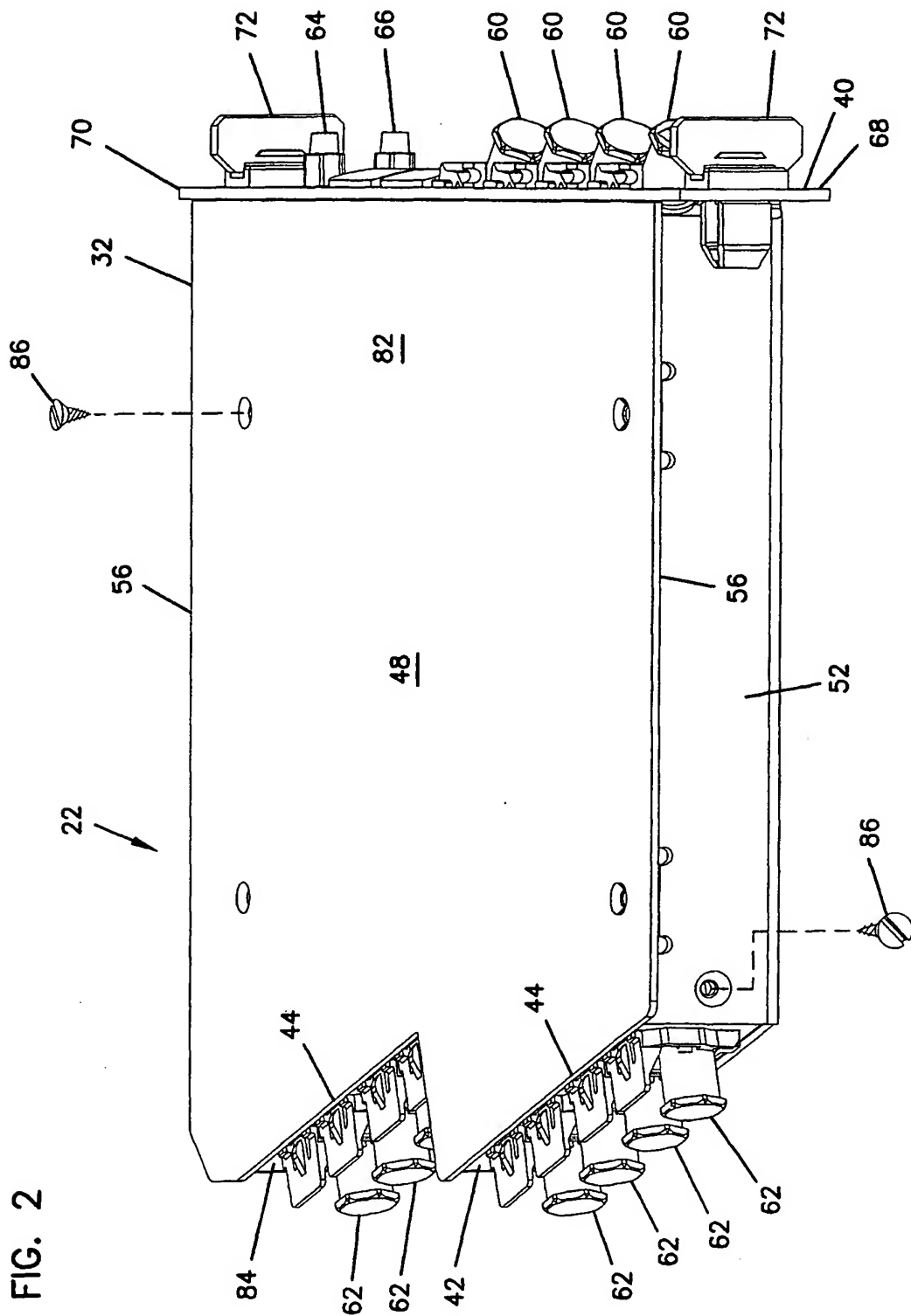


FIG. 1B





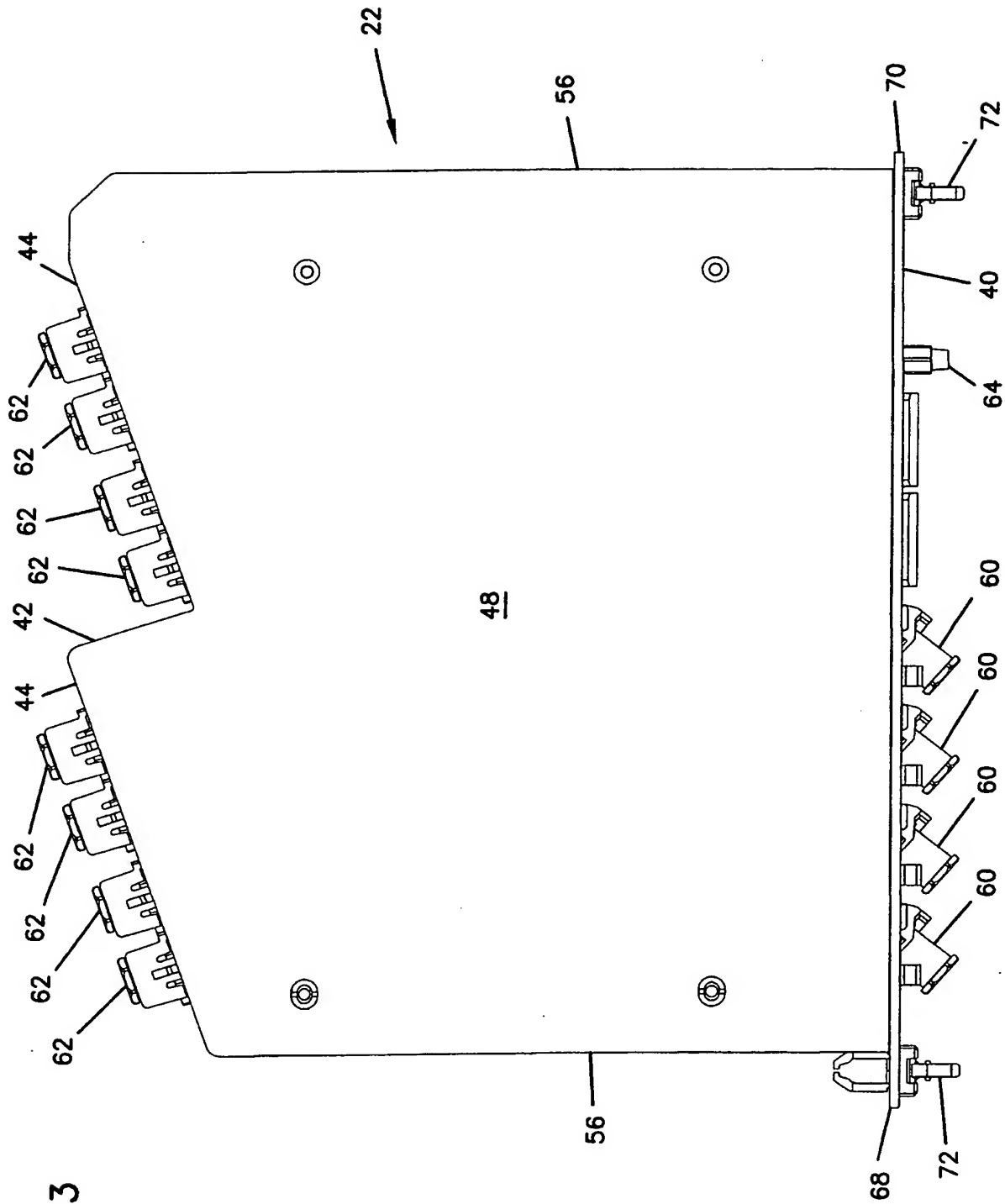


FIG. 3

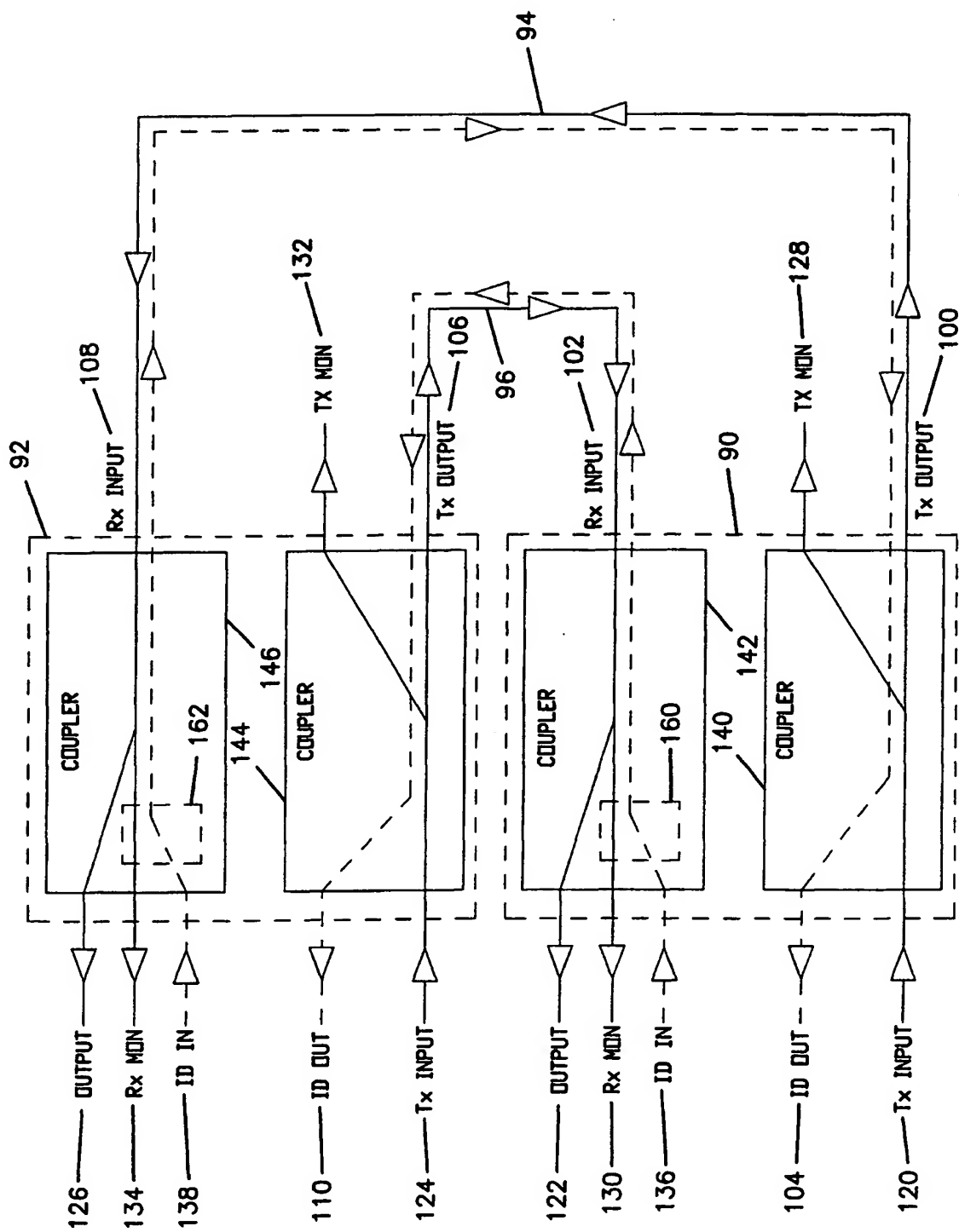


FIG. 6

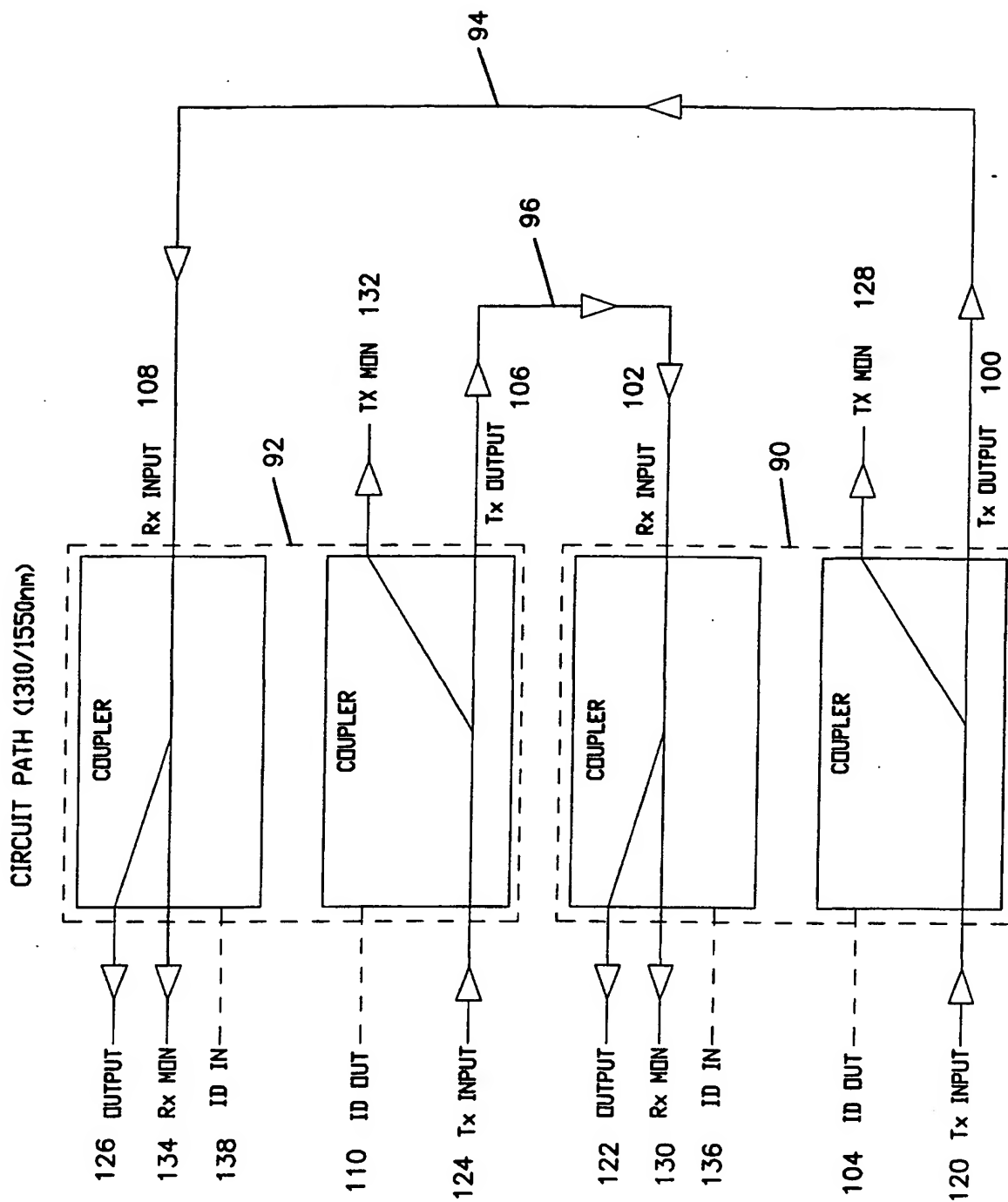


FIG. 7

FIG. 8

VISIBLE CONTINUITY CHECK AND IDENTIFIER (400-700nm)

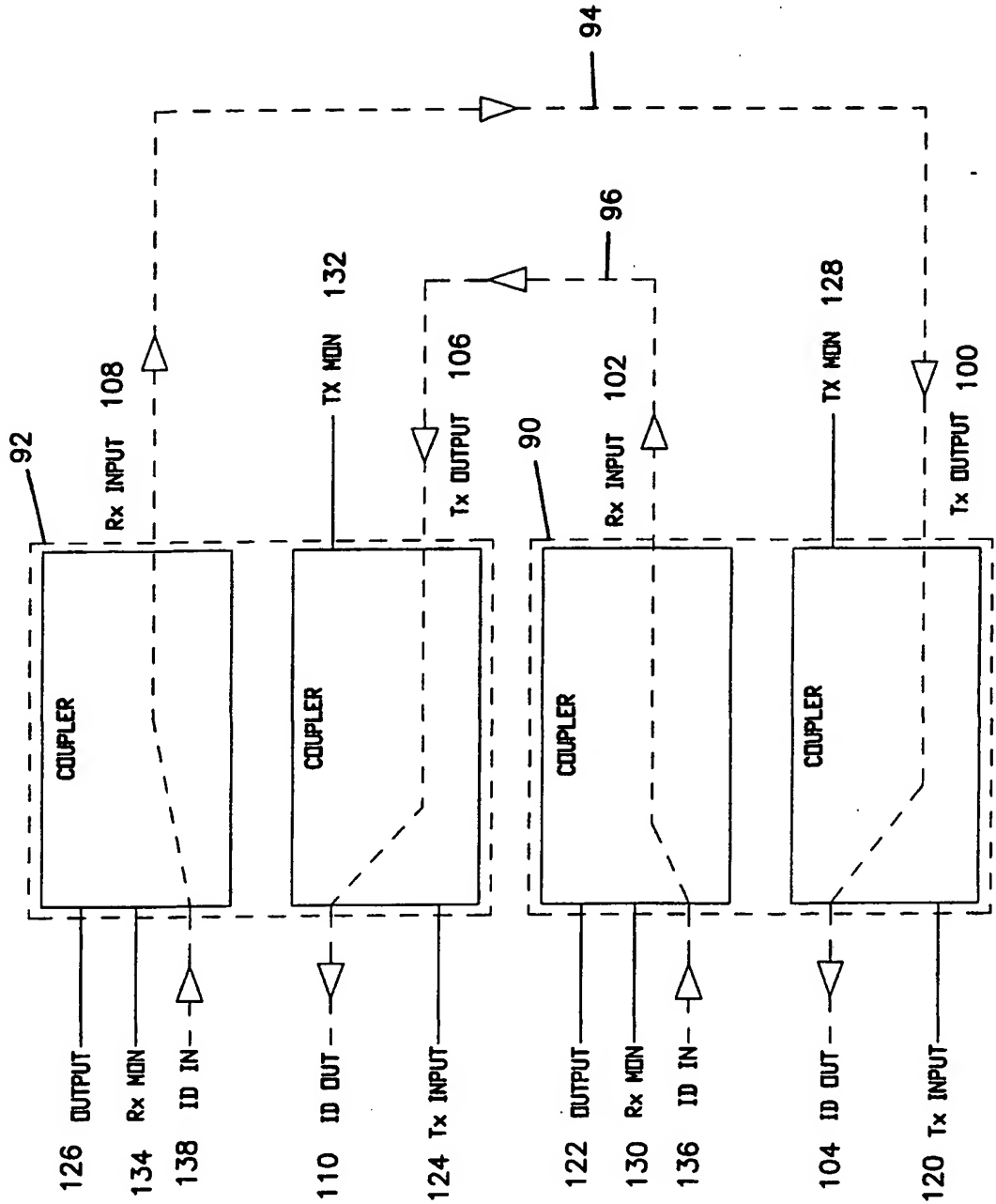


FIG. 9

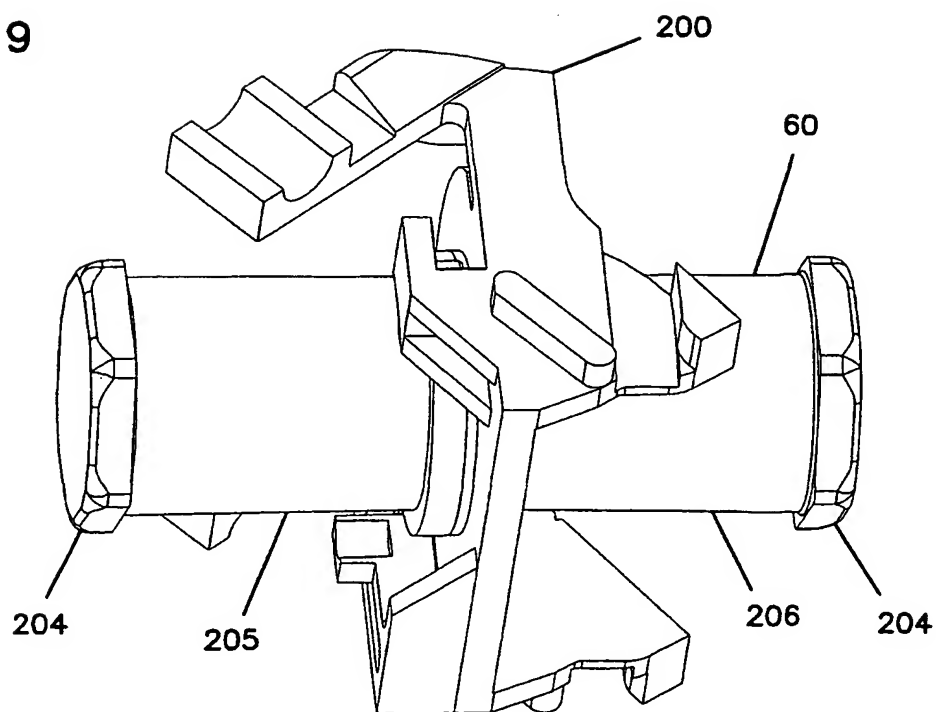


FIG. 10

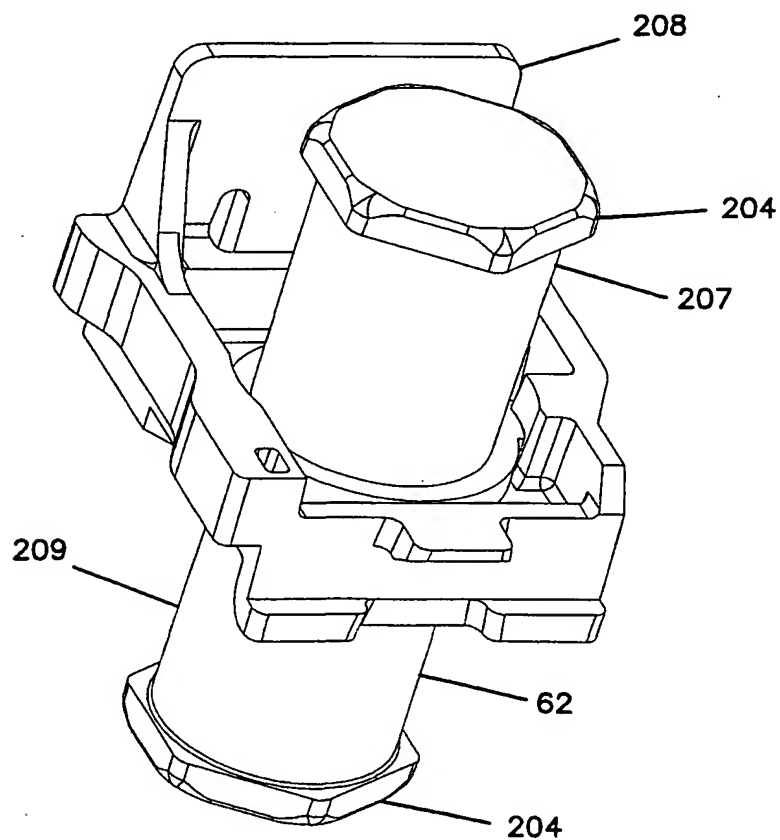
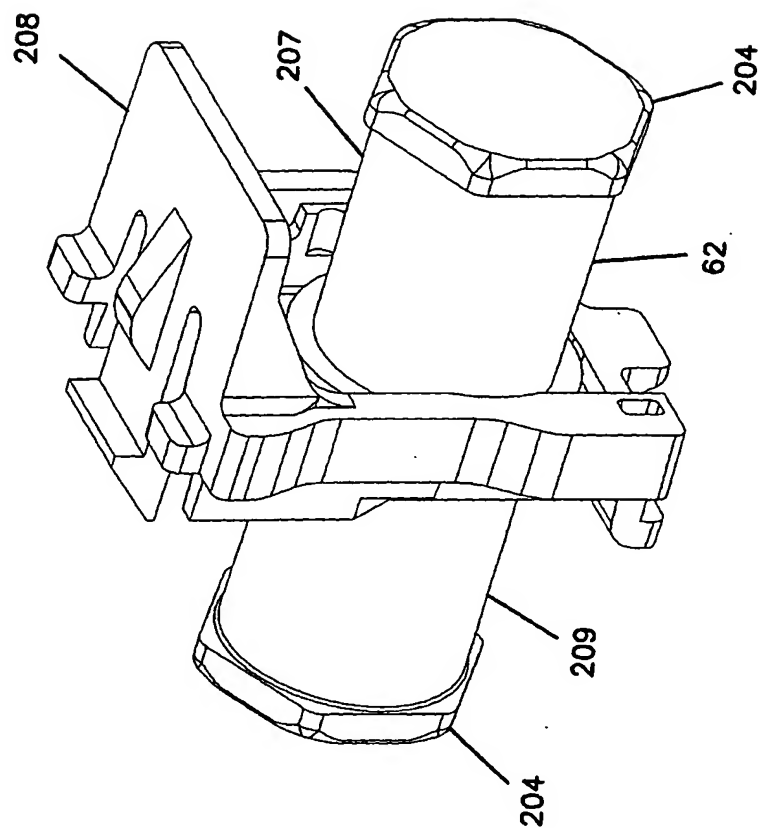


FIG. 11



12 / 15

FIG. 12

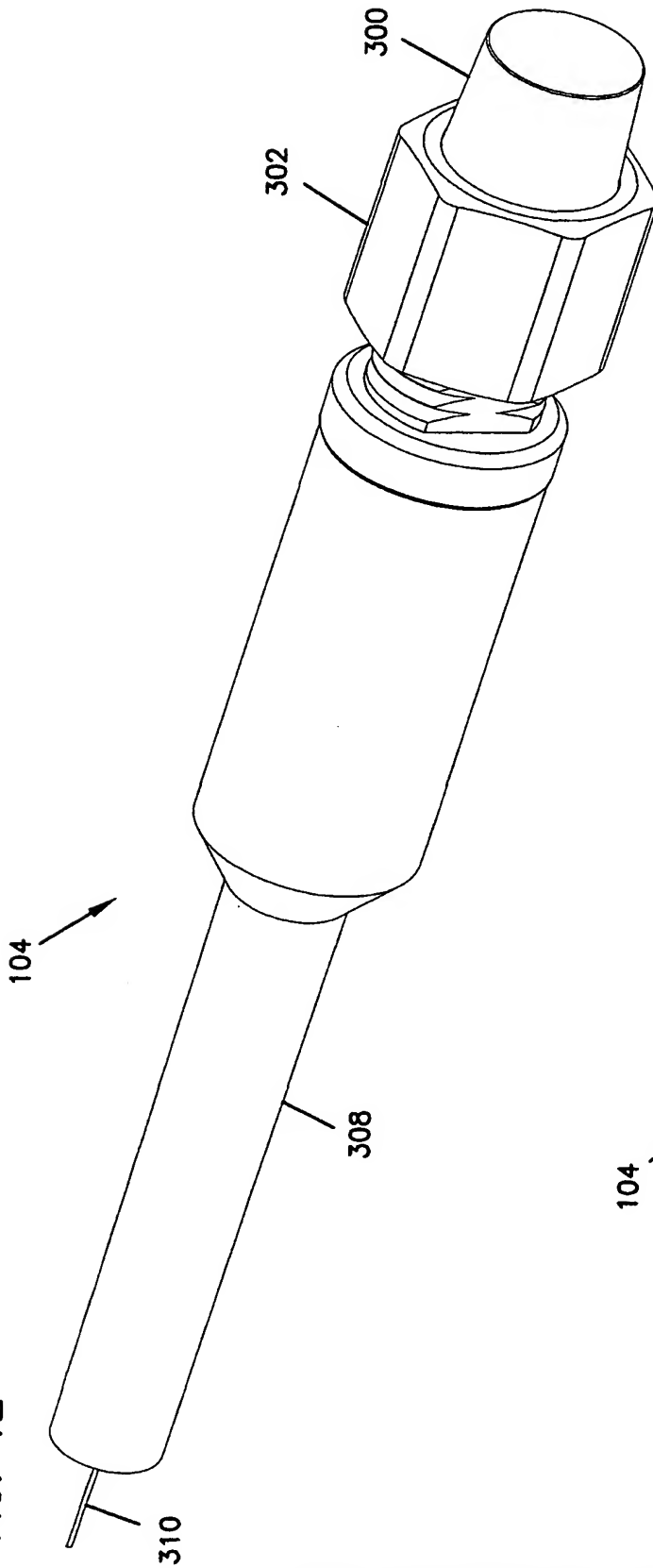
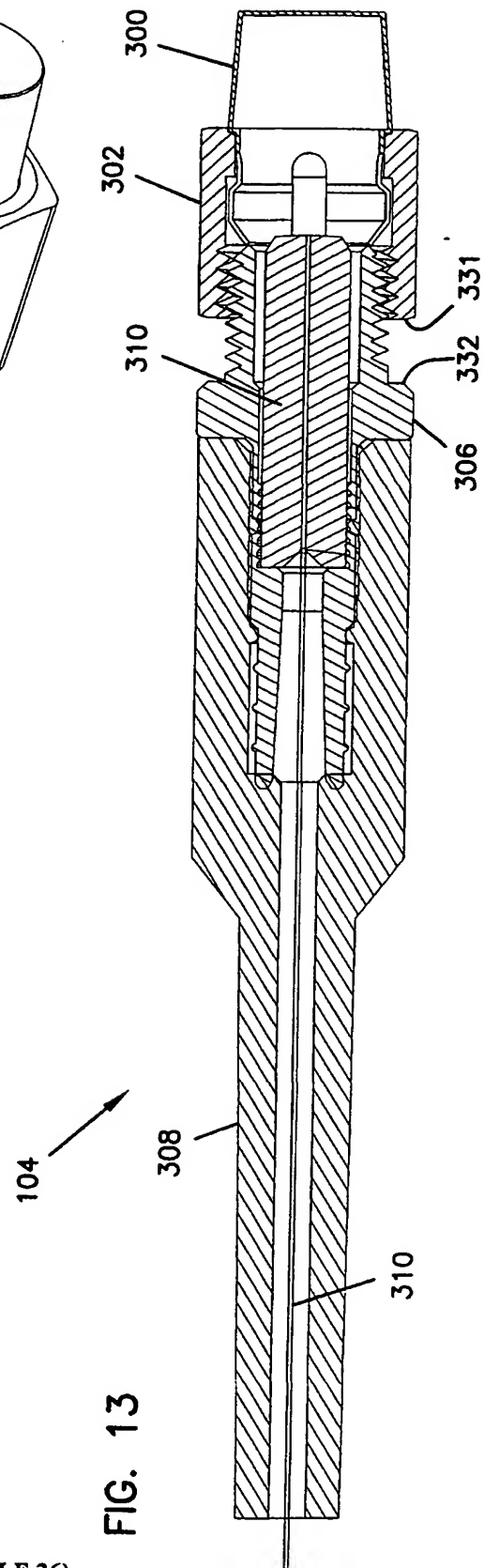


FIG. 13



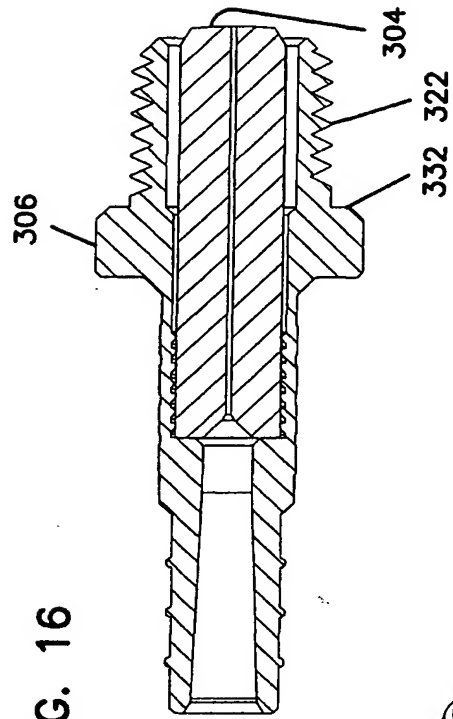


FIG. 16

FIG. 14

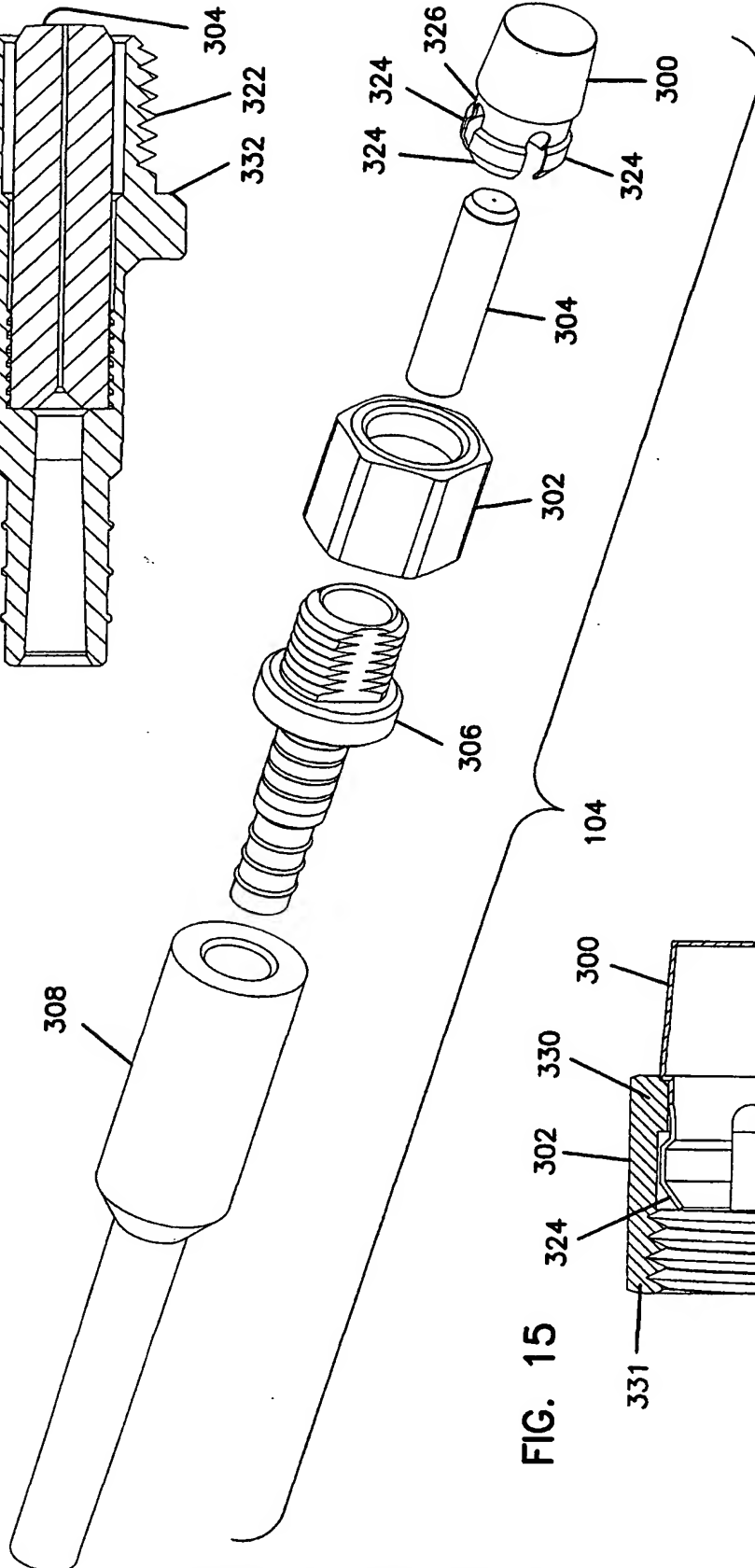


FIG. 15

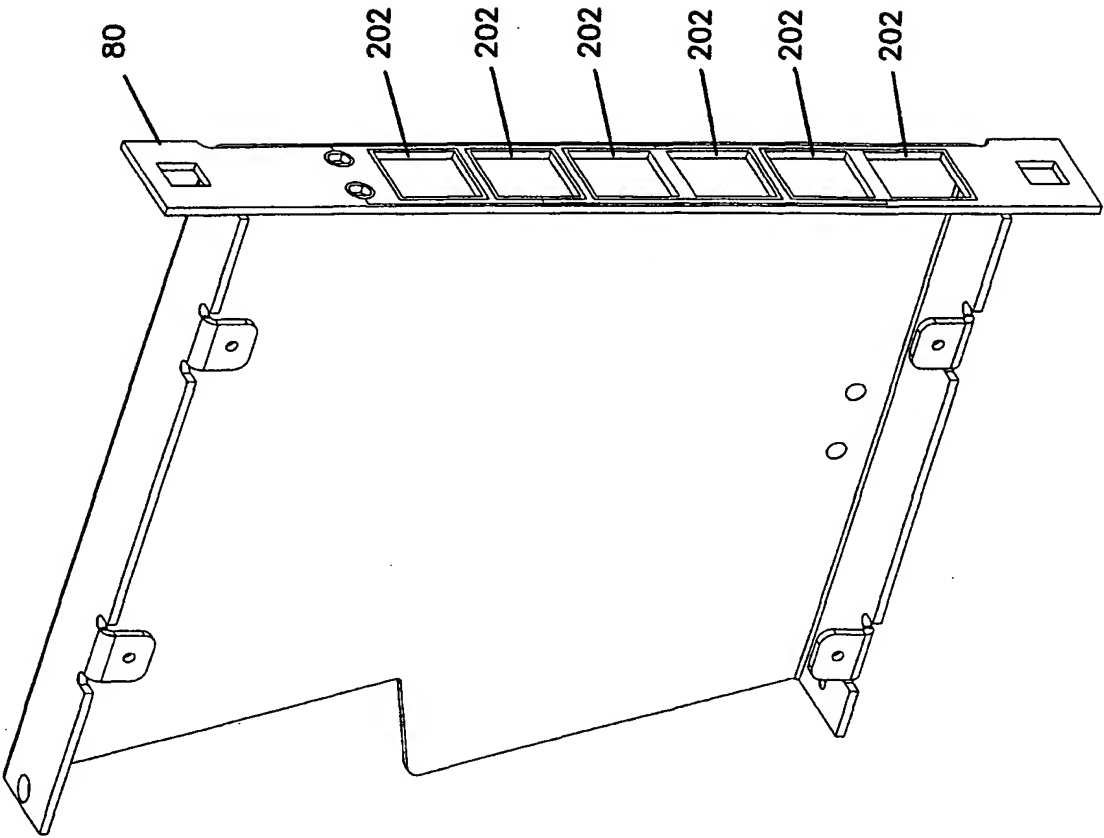
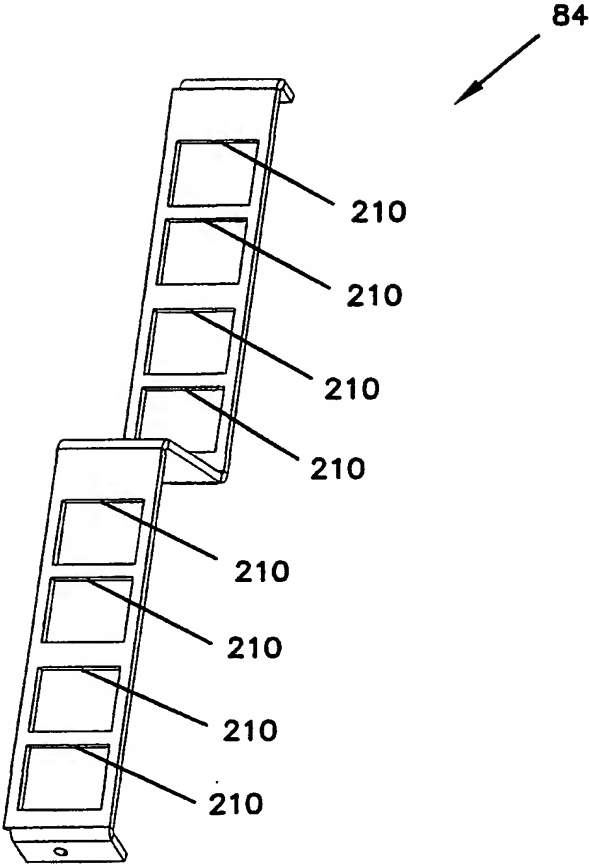


FIG. 17

FIG. 18



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/15840

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/44 F21V8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G02B G01M H04B F21V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 10, 31 October 1996 (1996-10-31) & JP 08 146238 A (NIPPON TELEGR &TELEPH CORP <NTT>), 7 June 1996 (1996-06-07) abstract; figure 1	16-19
A	---	1, 14
Y	EP 0 514 638 A (SIEMON CO) 25 November 1992 (1992-11-25) abstract; figures 1,5 column 4, line 1-8 column 5, line 1-25 ---	16-18
	--- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

14 March 2000

Date of mailing of the international search report

24.03.00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Beaven, G

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/15840

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 440 468 A (SAVAGE JR JOHN M) 8 August 1995 (1995-08-08) abstract; figures 1-3,5	19
A	---	15
Y	US 5 214 735 A (HENNEBERGER ROY L ET AL) 25 May 1993 (1993-05-25) abstract; figures 1,4-6	16,18
A	---	
A	US 5 774 245 A (BAKER PHILLIP E) 30 June 1998 (1998-06-30) abstract; figures 4,5,10 column 3, line 66 -column 4, line 48	1,14,16, 19
A	---	
A	US 5 432 875 A (KORKOWSKI JEFF L ET AL) 11 July 1995 (1995-07-11) abstract; figures 1,2 column 3, line 58 -column 4, line 3	1,14,16, 19
X	---	
X	DE 295 09 381 U (KAMPERS MICHAEL) 24 August 1995 (1995-08-24) page 6, line 4 -page 7, line 14 page 8, line 7-12; figures 1-8	15
X	---	
X	EP 0 443 454 A (PIRELLI CAVI SPA) 28 August 1991 (1991-08-28) abstract; figure 5 column 7, line 2-47	15
X	---	
X	US 4 732 450 A (LEE CHUN-SHEU) 22 March 1988 (1988-03-22) abstract; figure 3 column 2, line 53 -column 3, line 17	15
A	---	
A	US 4 782 430 A (ROBBINS JOHN A ET AL) 1 November 1988 (1988-11-01) abstract; figures 5-7 column 6, line 11-21	15
A	---	
A	US 5 303 125 A (MILLER JACK V) 12 April 1994 (1994-04-12) abstract; figure 1 -----	15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/15840

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: claim 1, 14, 16 & 19 (and dependent claims 2 - 13, 17, 18)

A fiber optic module comprising: a module housing; mounting flanges; a plurality of "exposed" first adapters along a front face; a plurality of "exposed" second adapters along a rear face

- wherein the plurality of first adapters define: a first signal transmit output port; a first signal receive input port; a first signal identification input port; a second signal transmit output port; a second signal receive input port; and a second signal identification port; wherein the plurality of second adapters define: a first signal transmit input port; a first signal receive output port; a second signal transmit input port; a second signal receive output port; a first signal transmit monitor port; a first signal receive monitor port; a second signal transmit monitor port; and a second signal receive monitor port;

- wherein the front face further includes first and second visual indicators;

- wherein the plurality of first adapters and the first and second visual indicators are positioned between the mounting flanges along the front face;

- and four optical couplers interconnecting the ports as defined in claim 1.

The associated technical problem thereby solved by these features being how to ensure signal monitoring and visual continuity checks for a pair of transceiver arrangements and how to house the components.

(N.b. claim 14 refers to a more compact module and has similar features except that on the rear face the first signal receive monitor also serves as a identification port and the second signal receive monitor also serves as a identification port and on the front face the signal identification input port and the signal identification port have been omitted; the four associated port couplers function in a similar fashion to claim 1. Claims 16 and 19 have also been searched even though they do not have all these features).

2. Claim : Claim 15

A fiber optic continuity indicator device for a fiber optic

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

module comprising a lens cap at least partially transparent to visible light; nut mounted to the lens cap; sleeve threadably mountable to the nut; a ferrule for holding an optical fiber, the ferrule mounted to the sleeve; the nut and the sleeve threadably mountable together to define a space for receipt of a portion of the housing of the fiber optic module. The associated technical problem thereby solved by these features being how to produce an indicator device that contains a lens cap and that is suitable for mounting in a housing.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/15840

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 08146238 A	07-06-1996	JP 2931219 B	09-08-1999
EP 0514638 A	25-11-1992	US 5127082 A	30-06-1992
		AT 174437 T	15-12-1998
		DE 69227798 D	21-01-1999
		DE 69227798 T	17-06-1999
US 5440468 A	08-08-1995	NONE	
US 5214735 A	25-05-1993	AU 4025993 A	08-11-1993
		CA 2133573 A	14-10-1993
		WO 9320466 A	14-10-1993
US 5774245 A	30-06-1998	WO 9741720 A	13-11-1997
US 5432875 A	11-07-1995	NONE	
DE 29509381 U	24-08-1995	NONE	
EP 0443454 A	28-08-1991	IT 1239223 B	28-09-1993
		BR 9100758 A	22-11-1994
		CA 2036588 A	21-08-1991
		JP 5019129 A	29-01-1993
		US 5095517 A	10-03-1992
US 4732450 A	22-03-1988	JP 61221705 A	02-10-1986
US 4782430 A	01-11-1988	NONE	
US 5303125 A	12-04-1994	NONE	